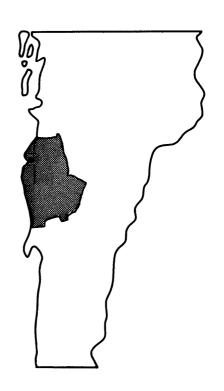


TOWN OF FERRISBURG, VERMONT ADDISON COUNTY



SEPTEMBER 18, 1986



Federal Emergency Management Agency

COMMUNITY NUMBER - 500002

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FLOOD INSURANCE STUDY TOWN OF FERRISBURG, ADDISON COUNTY, VERMONT

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Town of Ferrisburg, Addison County, Vermont, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in their efforts to promote sound flood plain management. Minimum flood plain management requirements for participation in the National Flood Insurance Program are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

This Flood Insurance Study was prepared by compiling pertinent information for the flood hazard areas in the Town of Ferrisburg from existing technical and/or scientific data originally prepared by others for purposes other than the preparation of this Flood Insurance Study. This existing data was reviewed by the Federal Emergency Management Agency (FEMA) prior to its use in the development of this Flood Insurance Study to ensure compliance with National Flood Insurance Program (NFIP) accuracy requirements.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic analyses for Otter Creek were performed by the New York District of the U. S. Army Corps of Engineers (COE) during the preparation of a Flood Plain Technical Services report for the creek. The hydraulic analyses for Otter Creek were performed by DuBois & King, Inc., under subcontract to the COE as part of the same report for Otter Creek. The COE report was completed in January 1985.

The hydrologic analyses for Lake Champlain were performed by Camp, Dresser & McKee, Environmental Engineers, during the preparation of the Flood Insurance Study for the Town of Plattsburgh, New York. The Plattsburgh study was completed in November 1977.

1.3 Coordination

On November 7, 1985, the results of the study were reviewed at a final Consultation and Coordination Officer's (CCO) meeting attended by representatives of FEMA and the Town of Ferrisburg.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Town of Ferrisburg, Addison County, Vermont. The area of study is shown on the Vicinity Map (Figure 1).

Otter Creek was studied by detailed methods for its entire length within the corporate limits. Lake Champlain was studied by detailed methods for its entire shoreline affecting Ferrisburg. The areas studied by detailed methods were selected based upon the extent and validity of available existing hydrologic and hydraulic data.

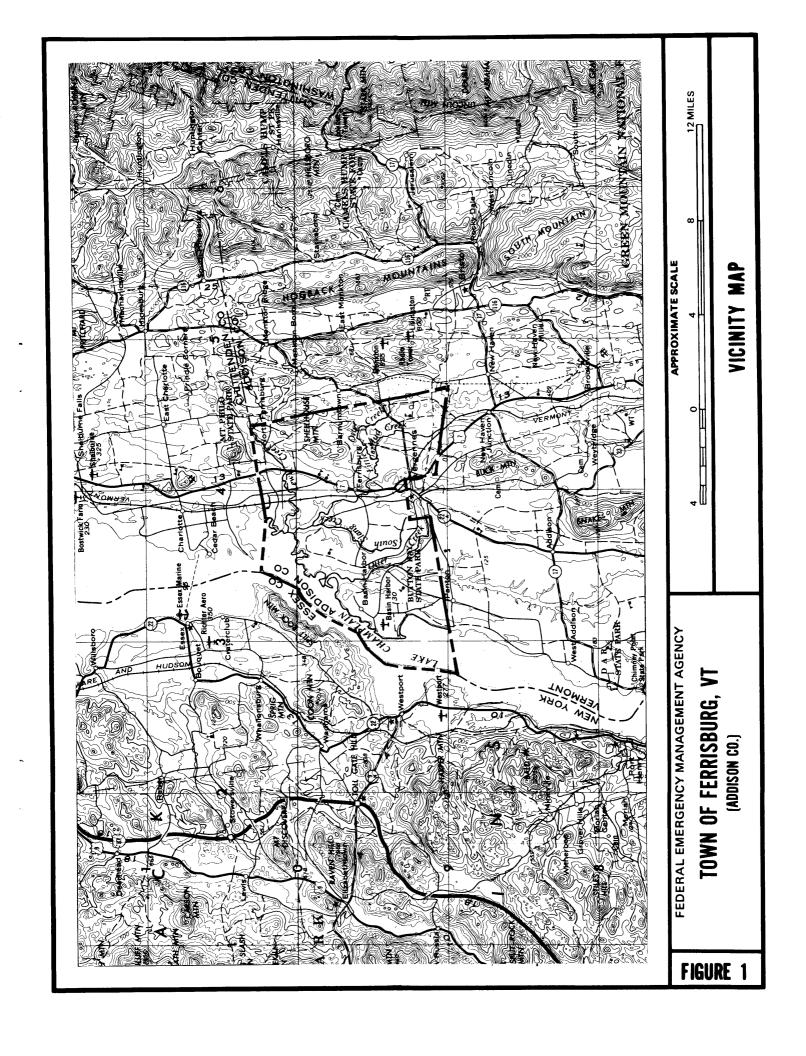
Little Otter Creek, Kimball Brook, Lewis Creek, Mud Creek, South Slang Creek, East Slang Creek, Goose Creek, and Dead Creek were studied by approximate methods. Approximate methods of analysis were used to study all remaining areas having a potential flood hazard that did not have available scientific or technical data.

2.2 Community Description

The Town of Ferrisburg is located in the northwestern portion of Addison County in western Vermont. It is bordered by the Town of Charlotte to the north; Lake Champlain to the west; the Towns of Panton, Waltham, and New Haven, and City of Vergennes to the south; and the Towns of Monkton and New Haven to the east. The population of Ferrisburg is approximately 2,120, and it has a land area of 39,104 acres (Reference 1).

2.3 Principal Flood Problems

Flood problems along Otter Creek are generally associated with spring runoff and summer thunderstorms. Ice jams along this stream have not been known to be a problem in the past, and they were not considered in this study.



2.4 Flood Protection Measures

There are no flood protection measures in the Otter Creek watershed.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency and peak elevation-frequency relationships for the flooding sources studied in detail affecting the community.

Discharges for Otter Creek were obtained from the COE Flood Plain
Technical Services report for Otter Creek (Reference 2). In the COE
report, discharges were developed through an analysis of the peak
discharge versus frequency curve for the U. S. Geological Survey (USGS)
stream gage located at Middlebury, Vermont, which is upstream of
Ferrisburg (Reference 3). A log-Pearson Type III statistical analysis,
as outlined by Water Resources Council Bulletin 17A, was performed for
the water year peaks (Reference 4). The periods of record for the
Middlebury gage were 1904 to 1906, 1911 to 1919, November 1927, and 1929
to 1983. The derived mean, standard deviation, and skew were 3.649,
0.148, and 0.259, respectively. The regional skew was determined to be
0.2, and the final adopted skew was calculated as 0.2. Based on physical
similarity between the Middlebury site and the Ferrisburg study site, a
drainage area ration to the 0.75 power was used to translate flood peaks

to the downstream sites, to a location above Dead Creek approximately 3 miles above the confluence of Otter Creek. For Dead Creek flood peaks, a synthetic flood frequency relationship was developed, and the coincidental flows from Dead Creek were determined through unit hydrograph analysis (Reference 5).

A summary of discharges for Otter Creek is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

	DRAINAGE AREA	PEAK DISCHARGES (cfs)			
FLOODING SOURCE AND LOCATION	(sq. miles)	10-YEAR	50-YEAR	100-YEAR	500-YEAR
OTTER CREEK					
Below Dead Creek	936	9,430	12,811	14,409	18,277
Below Vergennes Tributary	871	8,946	12,167	13,675	17,380

Flood elevations used in this study for Lake Champlain were taken at the Rouses Point gage north of the Town of Plattsburgh, New York, for the period from 1871 to 1976. Stages for the lake as determined for that locality were obtained from graphical frequency analyses of gage data using the Flood Insurance Study for Plattsburgh (Reference 6).

The lake water levels for the selected recurrence intervals were verified in a recent report for Lake Champlain. This report was to the International Joint Commission on Lake Champlain by the International Champlain-Richelieu Board (Reference 7).

A summary of peak-elevation frequency relationships for Lake Champlain is shown in Table 2, "Summary of Stillwater Elevations."

TABLE 2 - SUMMARY OF STILLWATER ELEVATIONS

		ELEVATIO	ON (feet)	
FLOODING SOURCE AND LOCATION	10-YEAR	50-YEAR	100-YEAR	500-YEAR
LAKE CHAMPLAIN				
At Plattsburg, New York	101.0	101.8	102.0	102.3

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the riverine flooding source studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross-section information was obtained through field measurements. Bridge plans were used to obtain structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Insurance Rate Map (Exhibit 2).

Roughness coefficients (Manning's "n") used in the hydraulic computations were estimated by field inspection at each cross section. The channel "n" values for Otter Creek ranged from 0.040 to 0.050, and the overbank "n" values ranged from 0.060 to 0.120.

Water-surface elevations of floods of the selected recurrence intervals were computed using the COE HEC-2 step-backwater computer program (Reference 8). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. Starting water-surface elevations for Otter Creek were based on the mean high lake level at its confluence with Lake Champlain.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3).

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages State and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100- and 500-year flood plain boundaries and 100-year floodway to assist communities in developing flood plain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for flood plain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For the riverine stream studied in detail, the 100- and 500-year flood plain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at scale of 1:24,000 and 1:62,500 with a contour interval of 20 feet (References 9 and 10). For Lake Champlain, the 100- and 500-year flood boundaries have been delineated using the topographic maps referenced above.

For the streams studied by approximate methods, the boundary of the 100-year flood was delineated using the Flood Hazard Boundary Map for Ferrisburg (Reference 11).

The 100- and 500-year flood plain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year flood plain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE), and the 500-year flood plain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year flood plain boundaries are close together, only the 100-year flood plain boundary has been shown. Small areas within the flood plain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the stream studied by approximate methods, only the 100-year flood plain boundary is shown on the Flood Insurance Rate Map (Exhibit 2).

4.2 Floodways

Encroachment on flood plains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood plain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal

standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodway in this study is presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodway presented in this study was computed for certain stream segments on the basis of equal conveyance reduction from each side of the flood plain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (Table 3). The computed floodway is shown on the Flood Insurance Rate Map (Exhibit 2). In cases where the floodway and 100-year flood plain boundaries are either close together or collinear, only the floodway boundary is shown.

The area between the floodway and 100-year flood plain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "Without Floodway" elevations presented in Table 3 for certain downstream cross sections of Otter Creek are lower than the regulatory flood elevations in that area, which must take into account the 100-year flooding due to backwater from other sources.

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year flood plains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown in this area.

			_
	INCREASE	0.00.00.00.00.00.00.00.00.00.00.00.00.0	
BASE FLOOD SURFACE ELEVATION	WITH FLOODWAY NGVD)	99.0 101.0 102.9 103.5	
BASE FLOOD WATER SURFACE EL	WITHOUT FLOODWAY (FEET	99.0 ² 100.6 ² 101.9 ² 102.5 103.6	
X	REGULATORY	102.0 102.0 102.0 102.5 103.6	
	MEAN VELOCITY (FEET PER SECOND)	4.7 2.2 2.2 2.2 2.2	
FLOODWAY	SECTION AREA (SQUARE FEET)		
	WIDTH (FEET)	530 532 493 521 568	
RCE	1 DISTANCE	6,000 10,800 17,300 20,300 25,200	
FLOODING SOURCE	CROSS SECTION	Otter Creek B C C E	

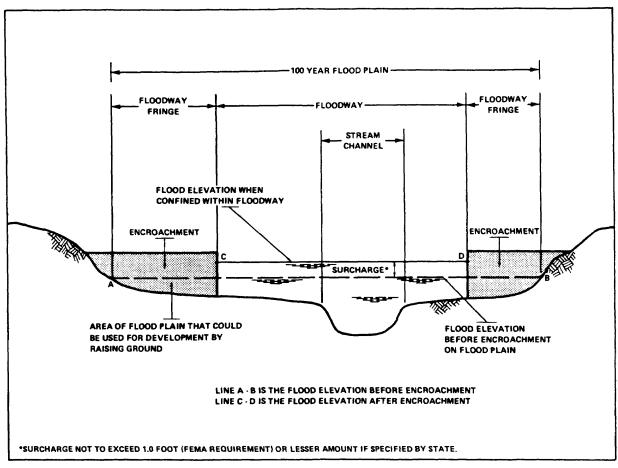
¹Feet above confluence with Lake Champlain
²Elevation computed without consideration of backwater from Lake Champlain

FEDERAL EMERGENCY MANAGEMENT AGENCY TOWN OF FERRISBURG, VT (ADDISON CO.)

FLOODWAY DATA

OTTER CREEK

TABLE 2



FLOODWAY SCHEMATIC

Figure 2

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year flood plains that are determined in the Flood Insurance Study by detailed methods. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 100-year flood plain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 100-year coastal flood plains that have additional hazards associated with storm waves. Zone V areas are determined by approximate methods, and base floods elevations are not shown.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal flood plains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year flood plain, areas within the 500-year flood plain, and to areas of 100-year shallow flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and flood plain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year flood plains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For flood plain management applications, the map shows by tints, screens, and symbols, the 100- and 500-year flood plains, the floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

7.0 OTHER STUDIES

This Flood Insurance Study was prepared by compiling existing hydrologic and hydraulic technical and scientific data prepared by other organizations originally for purposes other than the preparation of this Flood Insurance Study. The data were identified as the best available at the time of compilation of this Flood Insurance Study and should depict the general conditions of the flooding sources with relative accuracy. FEMA performed a cursory review and accepted the data as valid for purposes of this Flood Insurance Study and the NFIP. However, if better information is known to exist or has been developed since the date of this report, the information should be immediately forwarded to the Natural and Technological Hazards Division, Federal Emergency Management Agency (Regional Director, Region I Office, J. W. McCormack Post Office and Courthouse Building, Room 462, Boston, Massachusetts 02109) for consideration for revision of this study.

Flood Insurance Studies for the Towns of Charlotte and Hinesburg have been published (References 12 and 13). The results of those studies are in complete agreement with the results of this study for Ferrisburg.

Flood Insurance Studies for the Towns Panton and Waltham, and the City of Vergennes are currently being prepared (References 14, 15, and 16). The results of those studies will be in agreement with the results of this study.

Also, the Flood Insurance Study for the Town of New Haven is currently being revised to include the detailed analysis for Otter Creek (Reference 17). The results of that study will be in complete agreement with the results of this study.

A Flood Hazard Boundary Map has been published for the Town of Ferrisburg (Reference 11). The differences between the Flood Hazard Boundary Map and this study are justified due to the more detailed nature of this Flood Insurance Study.

This report either supersedes or is compatible with all previous studies published on streams studied in this report and should be considered authoritative for the purposes of the National Flood Insurance Program.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, Federal Emergency Management Agency, Regional Director, Region I Office, J. W. McCormack Post Office and Courthouse Building, Room 462, Boston, Massachusetts 02109.

9.0 BIBLIOGRAPHY AND REFERENCES

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- 15. Federal Emergency Management Agency, Flood Insurance Study, Town of Waltham, Addison County, Vermont (Unpublished).
- 16. Federal Emergency Management Agency, Flood Insurance Study, City of Vergennes, Addison County, Vermont (Unpublished).
- 17. Federal Emergency Management Agency, <u>Flood Insurance Study</u>, <u>Town of New</u> Haven, Addison County, Vermont (Unpublished).

EXHIBIT 3 - ELEVATION REFERENCE MARKS

Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 1	20	115.13	Spike set in root of 48-inch elm stump, 208 feet east of fence corner at 90° bend in Kellog Bay Road, 0.8 mile north from Basin Harbor Road intersection.
RM 2	20	102.83	Spike set in 12-inch elm tree, 230 feet north of farmhouse on east side of Basin Harbor Road, 2.1 miles north of Panton Road intersection.
RM 3	20	119.81	Spike set in root of 48-inch poplar tree on east side of Basin Harbor Road, 1.6 miles north of Panton Road intersection.
RM 4	20	141.75	Spike in root of 15-inch elm tree on east side of Basin Harbor Road, 0.65 mile north from Panton Road inter- section.

